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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/057,014	01/24/2002	Padmanabhan Krishnaraj	A5597/T41100	3611
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APPLIED MATERIALS, INC. 2881 SCOTT BLVD. M/S 2061 SANTA CLARA, CA 95050				SONG, MATTHEW J
ART UNIT		PAPER NUMBER		
		1765		

DATE MAILED: 05/05/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/057,014	KRISHNARAJ ET AL. <i>eb</i>
	Examiner Matthew J Song	Art Unit 1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 17 February 2004.
- 2a) This action is **FINAL**. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) 14-23 is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1-13 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ . |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of Group I in the paper filed on 2/17/2004 is acknowledged. The traversal is on the ground(s) that the patentability of Group II and III hinges on the patentability of the method claims of Group I because Group II and III are computer related inventions. This is not found persuasive because the apparatus as claimed can be used to practice another and materially different process. The apparatuses of Group II and III and the method of Group I encompass different statutory classes. The Examiner has shown one way distinctness as is required to properly restrict the different invention and Applicants have not shown an error in the reasons for restriction. A serious burden exists in the differing issues likely to arise during the prosecution of the different statutory classes of invention.

Applicants also traverse on the ground(s) that claims in each of the Groups II and III are linking claims. This is not found persuasive because there is no linking claim, as alleged by applicants. Applicants have not identified which claims are supposedly linking claims or reasons supporting why the claims qualifies as linking claims. A serious burden exists in the differing issues likely to arise during the prosecution of the different statutory classes of invention.

The requirement is still deemed proper and is therefore made FINAL.

2. This application contains claims 14-23 drawn to an invention nonelected with traverse in the paper filed on 2/17/2004. A complete reply to the final rejection must include cancellation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claim 6 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 6 recites, “a surface interior to the process chamber, the surface disposed to separate the plasma from the plasma coupling structure” in lines 8-9. There is no support in the instant specification for a surface, which separates plasma. The instant specification teaches a toroidal configuration produces field lines parallel to the interior chamber surfaces separating the coupling structure from the plasma, note page 6, lines 15-21. This suggests that the field lines, and the not the surface, is the means for separating the plasma

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claim 6 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 6 recites, “a surface interior to the process chamber, the surface disposed to separate the plasma from the plasma coupling structure” in lines 8-9. It is unclear how the

surface separates the plasma from the plasma coupling structure, when the instant specification teaches the field lines are responsible, note page 6, lines 15-21.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

8. Claim 1-2 and 4-5 are rejected under 35 U.S.C. 102(b) as being anticipated by Moslehi (US 5,252,178).

Moslehi discloses a method of plasma processing comprising flowing plasma deposition or etch gases into a process chamber in a continuous mode followed by flowing plasma gases in a continuous mode (Abstract), this continuous mode reads on applicant's without terminating the plasma. Moslehi teaches Plasma enhanced chemical vapor deposition (PECVD) silicon dioxide deposition using a combination of TEOS or DES, oxygen and argon with a cleaning gas combination of NF₃, oxygen and argon (col 11, ln 1-10), this reads on applicant's first and second gas mixtures include silicon-containing gas and oxygen-containing gas and the etchant gas includes a fluorine-containing gas. Moslehi teaches four deposition and etching cycles using the same process gases for each deposition step (col 11, ln 15 to col 12, ln 45 and Fig 11).

Moslehi discloses a local plasma processing and electrodes disposed within the chamber, this reads on applicant's plasma source disposed within the processing chamber (Fig 1 and col 3, ln 20-25). Moslehi discloses electrode lines are connected to a low frequency RF tuner and to ground to cause plasma generation (col 9, ln 15-35), where the difference in RF reads on applicant's applying an electrical bias to the substrate while flowing etchant gas.

9. Claims 1-2 and 4-5 are rejected under 35 U.S.C. 102(e) as being anticipated by Sandhu (US 2001/0028922).

Sandhu discloses reactant species include silicon species and oxygen species that can react to deposit a silicon dioxide film and an etchant gas of CF_4 , CHF_3 and NF_3 can be used ([0022]-[0029]). Sandhu also discloses an AC generator creates and RF bias between the plasma and substrate ([0033]). Sandhu also discloses providing a substrate in a plasma reactor and supplying process gases including a reactant species and etchant to the upper surface of the substrate and creating a plasma to deposit and etch the film (claim 1). Sandhu also teaches varying substrate bias or power can vary the deposition rate and conformality ([0038]). Sandhu also discloses varying the net deposition rate is continuously varied during the deposition by decreasing a partial pressure of the etchant in the reaction chamber (claims 1, 2, and 5), this reads on applicant's providing a first gaseous mixture, an etchant gas and a second gaseous mixture without terminating plasma because the deposition composition is continuously changed and contains both deposition gases and etchant gases.

Art Unit: 1765

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Moslehi (US 5,252,178) or Sandhu (US 2001/0028922) in view of Wang et al (US 6,167,834).

Moslehi or Sandhu teaches all of the limitations of claim 2, as discussed previously, except the bias has a power density approximately between 0.9-3.2 W/cm². The electrical bias in plasma process is well known in the art to be a result effective variable, note Hausmann (US 6,099,697) and Sandhu (US 2001/0028922) ([0038]). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Moslehi by optimizing the electrical bias to obtain same by conducting routine experimentation of a result effective variable.

12. Claims 6-10 and 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sandhu (US 2001/0028922) in view of Lane et al (US 5,061,838).

Sandhu discloses reactant species include silicon species and oxygen species that can react to deposit a silicon dioxide film and an etchant gas of CF₄, CHF₃ and NF₃ can be used ([0022]-[0029]). Sandhu also discloses an AC generator creates and RF bias between the plasma and substrate ([0033]). Sandhu also discloses providing a substrate in a plasma reactor and supplying process gases including a reactant species and etchant to the upper surface of the substrate and creating a plasma to deposit and etch the film (claim 1). Sandhu also teaches varying substrate bias or power can vary the deposition rate and conformality ([0038]). Sandhu also discloses varying the net deposition rate is continuously varied during the deposition by decreasing a partial pressure of the etchant in the reaction chamber (claims 1, 2, and 5).

Sandhu does not teach the plasma includes poloidal ion flow along field lines substantially parallel to the surface interior to the process chamber and disposed to separate the plasma from the plasma coupling structure.

In a method of generating plasma, note entire reference, Lane et al teaches a toroidal ECR reactor in which a poloidal magnetic field **66** is established in a plasma generating chamber. Lane et al also teaches the flow along field lines is substantially parallel to a surface interior to the process chamber (Fig 1 and Fig 6). Lane et al also teaches a microwave source **44** for generating plasma, this reads on applicant's plasma coupling structure because it generates a plasma. Lane et al also teaches the magnetic field configuration controls the plasma to guide it to the wafer while maintaining the plasma source region of the line of sight of the wafer (col 3, ln 45-68), this reads on applicant's poloidal flow is disposed to separate the plasma from the plasma

coupling structure. Lane et al also teaches the wafer can be powered with a RF source to create additional biasing if ion bombardment energies greater than 20eV are desired (col 4, ln 25-50). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Sandhu's plasma process with Lane et al's poloidal magnetic field to produce a more uniform plasma flux (col 14, ln 5-20 and col 6, ln 10-45).

Referring to claim 6, the Examiner interprets the claim to mean the field lines separate the plasma from the plasma coupling structure because instant specification teaches the field lines parallel to the chamber surfaces separating the coupling structure from the plasma, note page 6, ln 15-21. The combination of Sandhu and Lane et al teaches a toroidal reactor and field lines parallel to the surface interior, as applicants; therefore the field line will inherently separate plasma, as applicants. Also, the combination of Sandhu and Lane et al teaches surfaces parallel to the field lines, which inherently would be able to separate the plasma from the coupling structure.

Referring to claim 7, the combination of Sandhu and Lane et al teaches varying the net deposition at least one time during deposition by decreasing the partial pressure of the etchant in the reaction chamber, this reads on applicant's second gaseous mixture with terminating the plasma ('922 claims 1 and 5).

Referring to claim 8, the combination of Sandhu and Lane et al teaches an RF bias between the plasma and the substrate ('922 [0033]).

Referring to claims 9-10, the combination of Sandhu and Lane et al is silent to the power density. The electrical bias in plasma process is well known in the art to be a result effective variable, note Hausmann (US 6,099,697) and Sandhu (US 2001/0028922) ([0038]). Therefore, it

Art Unit: 1765

would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Sandhu and Lane et al by optimizing the electrical bias to obtain same by conducting routine experimentation of a result effective variable.

Referring to claim 12-13, the combination of Sandhu and Lane et al teaches a second gas mixture with a decreased partial pressure of etchant gas, this reads on applicant's second deposition gas is the same as the first deposition gas. The combination of Sandhu and Lane teaches silicon and oxygen containing gases and fluorine containing etchant gases.

13. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sandhu (US 2001/0028922) in view of Lane et al (US 5,061,838) as applied to claims 6-10 and 12-13 above, and further in view of Tobe et al (US 5,891,349).

The combination of Sandhu and Lane et al teaches all of the limitations of claim 11, as discussed previously, except the plasma is high-density plasma.

In a method of plasma enhanced CVD, note entire reference, Tobe et al teaches high density plasma has attracted attention of semiconductor engineers in plasma processing methods because high density plasma enables novel processing and improves processing efficiency. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify to modify the combination of Sandhu and Lane et al with Tobe's high-density plasma to improve processing efficiency in a plasma process.

14. Claims 6-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin (US 5,920,792) in view of Lane et al (US 5,061,838).

Lin teaches a high density plasma chemical vapor deposition (HDP-CVD) comprising forming a first layer on a substrate using a HDP-CVD composition, which contains a etching component and a deposition component and forming a second layer using a second composition which contains the same etching and deposition components but with a lower etching/depositing component ratio, this reads on applicant's second gaseous mixture without terminating the plasma (Claim 1).

Lin is silent to generating a plasma from a plasma coupling structure, wherein the plasma includes poloidal ion flow along field lines substantially parallel to a surface interior to the process chamber and disposed to separate the plasma from the plasma coupling structure.

In a method of generating plasma, note entire reference, Lane et al teaches a toroidal ECR reactor in which a poloidal magnetic field **66** is established in a plasma generating chamber. Lane et al also teaches the flow along field lines is substantially parallel to a surface interior to the process chamber (Fig 1 and Fig 6). Lane et al also teaches a microwave source **44** for generating plasma, this read on applicant's plasma coupling structure because it generates a plasma. Lane et al also teaches the magnetic field configuration controls the plasma to guide it to the wafer while maintaining the plasma source region of the line of sight of the wafer, this reads on applicant's poloidal flow is disposed to separate the plasma from the plasma coupling structure. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Lin's plasma process with Lane et al's poloidal magnetic field to produce a more uniform plasma flux (col 14, ln 5-20 and col 6, ln 10-45)

Referring to claim 6, the Examiner interprets the claim to mean the field lines separate the plasma from the plasma coupling structure because instant specification teaches the field

lines parallel to the chamber surfaces separating the coupling structure from the plasma, note page 6, ln 15-21. The combination of Lin and Lane et al teaches a toroidal reactor and field lines parallel to the surface interior, as applicants; therefore the field line will inherently separate plasma, as applicants. Also, the combination of Lin and Lane et al teaches surfaces parallel to the field lines, which inherently would be able to separate the plasma from the coupling structure.

Referring to claim 8, the combination of Lin and Lane et al teach applying a bias to the wafer using RF power, this reads on applicant's applying an electrical bias to the substrate.

Referring to claims 9-10, the combination of Lin and Lane al is silent to the power density. The electrical bias in plasma process is well known in the art to be a result effective variable, note Hausmann (US 6,099,697) and Sandhu (US 2001/0028922) ([0038]). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Lin and Lane al by optimizing the electrical bias to obtain same by conducting routine experimentation of a result effective variable.

Referring to claims 11-12, the combination of Lin and Lane et al teaches a high density plasma process where the same etching and deposition gases are used in both layers, this reads on applicant's second deposition gas is substantially the same as the second gas (col 7, ln 45-55 and Claim 1).

Response to Arguments

15. Applicant's arguments filed 2/17/2004 have been fully considered but they are not persuasive.

Applicants' argument that Moslehi does not teach a plasma source disposed within the process chamber is noted but is not found persuasive. Moslehi teaches a localized plasma is a plasma that a plasma-generating charged electrode formed within the process chamber from a process gas medium capable of generating a plasma (col 1, ln 50-55) and a cylindrical electrode **66** is sufficiently small to fit within the diameter of the plasma process chamber collar **38**, which is used to generate plasma (col 6, ln 20-25 and col 8, ln 15-20); therefore Moslehi does teach a plasma source within the process chamber.

Applicants' argument that Moslehi does not teach etching part of the first portion of the film is noted but is not found persuasive. Moslehi teaches depositing silicon oxide and cleaning the chamber using argon and CF₄ or argon and NF₃ (col 9, ln 1-15), which are same etchant gases used by applicants' to etch a silicon oxide film, note page 14, lines 1-10. Therefore, etching inherently occurs because Moslehi teaches using similar etchant gases and deposition of silicon oxide, as applicants. It is also noted that the chamber walls, which are being cleaned by CF₄ or NF₃, which are well known etchants, reads on applicants' substrate because deposition does occur on the surface of the chamber walls and the cleaning gases then remove the deposited materials, as applicants.

Applicants' argument that Moslehi does not teach cleaning cycles be performed with a wafer that has previously undergone a deposition cycle and remains in the chamber is noted but is not found persuasive. Moslehi teaches effective in-situ chamber cleaning during or after a deposition or etch process (col 4, ln 50-55); therefore Moslehi does teach using the cleaning gas while the substrate is present because the cleaning can occur **during** deposition or after deposition. It is also noted that the chamber walls reads on applicant's substrate and deposited

does occur on the surface of the chamber walls and the deposited materials are removed by using CF₄ or NF₃ plasma, as applicants; therefore etching of the deposited material inherently occurs.

Applicants' argument that Sandhu does not teach a plasma source disposed within the process chamber is noted but is not found persuasive. Sandhu teaches the reactor designs using energy source including either thermal heating, inductively coupled RF plasma, capacitively coupled RF plasma or the like may be used ([0034]). Capacitively coupled RF plasma is well known in the art to require a wafer on an electrode and opposite an other planar electrode and forming a plasma between the two electrodes, as evidenced by applicants' admitted prior art on page 2, lines 9-20 of the instant specification. Therefore, an electrode supporting a substrate used for generating plasma in a capacitively coupled RF plasma reactor requires a plasma source within the chamber.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., the etching component dominates over the deposition component) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Sandhu teaches concurrent etch/deposit processes, where etching and deposition occur simultaneously ([0040]). Sandhu teaches deposition using a first gas mixture, etching using an etchant gas and deposition using a second gas mixture; therefore meets the limitations of claim 1.

Applicants' argument that Lane does not teach a plasma coupling structure disposed within the process chamber is noted but is not found persuasive. Lane et al teaches an inner coil 12, which is disposed in the interior of the reactor 100; therefore the coil 12 reads on applicants'

coupling structure. It is also noted that Sandhu and Moslehi teach electrodes used for plasma generation disposed within a reactor, as discussed previously; therefore Lane is not required to teach a coupling structure disposed within a chamber.

Conclusion

16. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Hausmann (US 6,099,697) teaches electrical bias and other chamber conditions are optimized during wafer processing in a plasma process (col 1, ln 24-65).

17. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Art Unit: 1765

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew J Song
Examiner
Art Unit 1765

MJS

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER
